

AIR CONDITIONING TECHNOLOGY

Program of Studies
2014-2015



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Kentucky Department of Education
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Air conditioning Technology

Course Title	Post-Secondary Connection	Valid Course Code	Recommended Grade Level							Credit
			6	7	8	9	10	11	12	
Commercial Refrigeration	ACR 200	470211						X	X	.5
Commercial Refrigeration LAB	ACR 201	470212						X	X	.5
Cooling & Dehumidification	ACR 250	470213						X	X	.5
Cooling & Dehumidification LAB	ACR 251	470214						X	X	.5
CO-OP (Air Cond)	ACR 199	460880							X	1
Digital Literacy	DLC 100	480101				X	X	X	X	1
Electrical Components	ACR 130	470215						X	X	.5
Electrical Components LAB	ACR 131	470216						X	X	.5
Fundamentals of Math	MTH 100	470818					X	X	X	.5
Green Awareness/Energy Management	ACR 280	460806						X	X	.5
Green Awareness/Energy Management LAB	ACR 281	460807						X	X	.5
Heat Load/Duct Design	ACR 170	480812						X	X	.5
Heat Pump Application	ACR270	460801						X	X	1
Heat Pump Application LAB	ACR 271	460802						X	X	.5
Heating & Humidification	ACR 260	460820						X	X	.5
Heating & Humidification LAB	ACR 261	460821						X	X	.5
HVAC Electricity	ACR102	460817						X	X	.5
HVAC Electricity LAB	ACR 103	460816						X	X	.5
Ice Machines	ACR210	460845						X	X	.5
Industrial Safety	ISX 100	460301				X	X	X	X	.5
Internship (Air Cond)	ACR 198	460883						X	X	1
Journeyman Prep	ACR 290	460846						X	X	.5
Refrigeration Fundamentals	ACR 100	470219					X	X	X	.5
Refrigeration fundamentals LAB	ACR 101	470220					X	X	X	.5
Residential Energy Auditor Prep	ACR 295	460804						X	X	.5
Residential Energy Auditor Prep LAB	ACR 296	460805						X	X	.5
Sheet Metal Fabrication	ACR112	460847						X	X	.5
Sheet Metal Fabrication LAB	ACR 113	460848						X	X	.5
Workplace Readiness	WPP 200	060191					X	X	X	.5

AIR CONDITIONING TECHNOLOGY

Program Description: (Overview)

The Construction Technology programs will prepare students for work in new construction, remodel, and energy auditing industries. Course offerings include everything from entry level trades courses, all the way to national certification. Students will train at the career centers, high schools and at real jobsites. Current and traditional building practices are included, while updated and advanced framing techniques, energy efficiency, health and safety, and sustainability methods are emphasized.

Construction Pre-Apprenticeship courses are included that focus on new construction, carpentry, and other building trades. Students learn about the tools and techniques used in the construction industries. The students may gain skills in Air Conditioning Technology, Building and Apartment Maintenance, Carpentry, Electrical Technology, Masonry and Plumbing. They are also introduced to green building methods and materials. The Building Performance and Energy Assessment courses shift that focus to analyzing existing homes.

Weatherization, Building Performance and Energy Assessment industries are helping families reduce their energy burden, while maintaining comfort and safety. Our students will learn the national standard and protocols for energy auditing, combustion appliance safety, and energy modeling. Successful students are prepared to take the national certification exams for building analysts and energy auditors.

Course offerings are intended to promote career ladders for those just entering the industry, as well as industry professionals looking to stay current. There are multiple certificates and degree options and inter-related disciplines at the Career Centers having articulation agreements with various post secondary institutions.

MODEL COURSE SEQUENCE

KDE/OCTE Career Pathways Air Conditioning Technology		
Career Pathway	Core Courses	Elective Courses
Environmental System Repair Helper CIP Code: 47.0201.00 <u>Tests for Certification</u> <ul style="list-style-type: none"> • KOSSA – Construction Test • NCCER – Core Curriculum • NCCER – HVAC Level 1 	<ul style="list-style-type: none"> • Refrigeration Fundamentals/Lab 470219/220 • HVAC Electricity/Lab 460817/816 • Heating & Humidification/Lab 460820/821 • Cooling & Dehumidification/Lab 470213/214 	<ul style="list-style-type: none"> • Industrial Safety 460301 • Electrical Components/Lab 470215 • Ice Machines 460845 • Residential energy Auditor 460883 • Digital Literacy 480101
Environmental Control System Helper CIP Code: 47.0201.01 <u>Tests for Certification</u> <ul style="list-style-type: none"> • KOSSA – Construction Test • NCCER – Core Curriculum • NCCER – HVAC Level 1 	<ul style="list-style-type: none"> • Refrigeration Fundamentals/Lab 470219/220 • HVAC Electricity/Lab 460817/816 • Electrical Components/Lab 470215/216 • Heat Pump Applications/Lab 460801/802 	<ul style="list-style-type: none"> • Sheet Metal Fabrication/Lab 460847 • Residential Energy Auditor 460804 • Heating & Humidification/Lab 460820 • Cooling & Dehumidification/Lab 470213

<p style="text-align: center;">Domestic Air Conditioner and Furnace Installer CIP Code 47.0201.02</p> <p><u>Tests for Certification</u></p> <ul style="list-style-type: none"> • KOSSA – Construction Test • NCCER – Core Curriculum • NCCER – HVAC Level 1 	<ul style="list-style-type: none"> • Cooling & Dehumidification 470213/214 • Electrical Components/Lab 470215/216 • Heat Load/Duct Design 480812 • Heating & Humidification/Lab 460820/821 • Refrigeration Fundamentals/Lab 470219/220 	<ul style="list-style-type: none"> • Heat Pump Application/Lab 460801/802 • HVAC Electricity/Lab 460817/816 • Journeyman Prep 460846 • Sheet Metal Fabrication/Lab 460847/848
<p>Refrigeration Mechanic CIP Code 47.0201.03</p> <p><u>Tests for Certification</u></p> <ul style="list-style-type: none"> • KOSSA – Construction Test • NCCER – Core Curriculum • NCCER – HVAC Level 1 	<ul style="list-style-type: none"> • Commercial Refrigeration/Lab 470211/212 • Cooling & Dehumidification/Lab 470213/214 • HVAC Electricity/Lab 461817/816 • Refrigeration Fundamentals/Lab 470219/220 	<ul style="list-style-type: none"> • Electrical Components/Lab 470215/216 • Ice Machines 460845 • Green Awareness/Energy Management 460806 • Fundamentals of Math 470818 • CO-OP 460880

MODEL COURSE SEQUENCE

KDE/OCTE Career Pathways Air Conditioning Technology

Career Pathway	Core Courses	Elective Courses
Environmental Control System Servicer Helper CIP Code:47.0201.04 <u>Test for Certification</u> <ul style="list-style-type: none">• KOSSA-Construction Test• NCCER-Core Curriculum• NCCER-HVAC Level 1• EPA- Section 608 Recovery	<ul style="list-style-type: none">• Refrigeration Fundamentals 470219• Refrigeration Fundamentals Lab 470220• HVAC Electricity 460817• HVAC Electricity Lab 460816• Cooling & Dehumidification 470213• Cooling &Dehumidification Lab 470214• Electrical Components 470215• Electrical Components Lab 470216• Heating &Humidification 460820• Heating & Humidification Lab 460821	<ul style="list-style-type: none">• Heat Pump Application 460801• Heat Pump Application Lab 460802• Journeyman Prep 460846

SAMPLE CAREER PATHWAY/AIR CONDITIONING

KENTUCKY CAREER PATHWAY/PROGRAM OF STUDY TEMPLATE

SA

COLLEGE/UNIVERSITY: Eastern Kentucky University
CLUSTER: Construction
HIGH SCHOOL (S): Barren County High School
PATHWAY: Construction Management
PROGRAM: HVAC

	GRADE	ENGLISH	MATH	SCIENCE	SOCIAL STUDIES	REQUIRED COURSES RECOMMENDED ELECTIVE COURSES OTHER ELECTIVE COURSES CAREER AND TECHNICAL EDUCATION COURSES	CREDENTIAL CERTIFICATE DIPLOMA DEGREE	SAMPLE OCCUPATIONS
SECONDARY	9	English I	Algebra I	Earth Science	Economics	History and Appreciation of Visual and Performing Arts Elective Computer Applications		
	10	English II	See Construction Geometry	Biology	U.S. History	Elective Elective	REF FUN / Lab ACR100/101	
	11	English III	Algebra II	Physical Science	World Geography	Health & PE Elective	HVAC Ele SYS ACR 102/103 Career Major	
	12	English IV	4th Math			Commercial REF / Lab ACR 200/201 Heat Hum Lab ACR 260/261 Cooling & Dehumidification / Lab ACR 250/251	H.S. Graduate Env Systems Rep Helper 49-9021 .01.01 *ONet Certificates	HVAC Repair Technician Assistant
		Take ACT - Apply for admission to Eastern Kentucky University						
POSTSECONDARY	Year 13	Writing	Math	Science	Computer Applications	Materials and Methods of Construction Intro to Construction	Estimating	
	Year 14	Communications	Math	Humanities	Social Interaction	Plane Surveying Managerial Reports	Soils and Foundations	
	Year 15	Communications	Humanities	Psychology	Economics	Construction Contracts Estimating II	Occupational Safety	
	Year 16	Arts and Humanities	Math	Science		Structural Systems Strength of Materials Surveying	Bachelor's Degree	Construction Manager



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Note: Categories of courses (e.g. Required, Recommended Electives, other Electives and career and Technical Education) apply to both secondary and postsecondary levels.

REFRIGERATION FUNDAMENTALS

470219

Course Description:

Introduces the fundamentals of refrigeration, refrigeration terms, and the basic refrigeration cycle. Proper use of tools, test equipment, and materials is stressed. Environmental issues including refrigerant handling are discussed. Refrigerant piping and methods used to join them are taught. General and specific safety is emphasized.

Content/Process

Students will:

- 1 Practice/observe safety practices/techniques**
- 2 Explain the history of refrigeration**
- 3 Compare the benefits of closed vs. open system**
- 4 Identify and explain the operation of the four major components**
- 5 Identify the high and low sides of the system**
- 6 Define matter and heat**
- 7 Distinguish between the three states of matter**
- 8 Explain the direction and rate of heat flow**
- 9 Describe the three methods of heat transfer**
- 10 Identify the reference points of temperature: boiling point, freezing point, critical temperature, absolute zero**
- 11 Explain the difference between heat and temperature**
- 12 Explain the differences between latent and sensible heat**
- 13 Explain the relationship of pressures and fluids at different temperatures**
- 14 Calculate absolute and gauge pressures**
- 15 Measure absolute and gauge pressures**
- 16 Explain how fluids react in a closed vs. open system**
- 17 Compare temperature with pressure (P/T Chart)**
- 18 Explain why fluids flow**
- 19 Define the properties of refrigerants**
- 20 Explain the uses of different refrigerants**
- 21 Identify color coding of refrigerant cylinders**
- 22 Explain classifications of refrigerants**

- 23 List proper transfer and storage of refrigerants**
- 24 Explain the four parts of the refrigeration cycle**
- 25 Draw a refrigeration system on a pressure-enthalpy (Ph) chart**
- 26 Explain the benefits of superheat and sub cooling**
- 27 Identify the effects of improper refrigerant in a system**
- 28 Identify basic tools and accessories: various screwdrivers, nutdrivers, socket wrenches, Allen (hex) wrenches, open- and box-end wrenches, flare wrench**
- 29 Identify power tools: general-purpose drill, power screwdriver, hammer drill, reciprocating saw, screw gun, etc.**
- 30 Identify fasteners: bolts, screws, masonry anchors, various electrical connectors, conduit, pipe and cable clamps, nails, etc.**
- 31 Identify pipe and tubing tools: pipe cutters, reamers and threaders, tubing cutters and reamers, benders, flaring tools, swaging tools, pipe vises, etc.**
- 32 Describe lubrication methods utilizing: grease guns, oilers, sprays**
- 33 Measure pressures with the refrigeration gauge manifold**
- 34 Evacuate systems with a two-stage vacuum pump**
- 35 Measure vacuums with a thermistor vacuum gauge**
- 36 Measure temperatures with various thermometers**
- 37 Charge a system with an electronic charging scale**
- 38 Check for leaks with electronic leak detector dye and electrosonic**
- 39 Identify types of pipe and tubing used in refrigeration work**
- 40 Identify various types of fittings**
- 41 Describe methods of insulating pipe and tubing**
- 42 Identify soldering and brazing alloys used in HVACR**
- 43 Explain applications of soldering and brazing alloys**
- 44 Flare copper tubing**
- 45 Swag copper tubing**
- 46 Bend copper tubing**
- 47 Identify types of torches**
- 48 Solder and braze copper tubing**
- 49 Cut and thread iron pipe**
- 50 Describe heat sink methods**
- 51 Describe heat exchange techniques**

- 52 Explain saturation temperature**
- 53 Determine the METD (Mean Effective Temperature Difference)**
- 54 Check for and repair refrigerant leaks**
- 55 Measure temperatures with bimetal and glass stem thermometers**
- 56 Describe the applications of vibration eliminators**
- 57 Identify types of evaporators: bare-tube, finned, plate, unit coolers, chillers**
- 58 Explain the operation performance of a condenser**
- 59 Charge system with refrigerant on liquid side as well as suction side**
- 60 Test and adjust all operating and safety controls**
- 61 Replace filter driers**
- 62 Inspect electrical circuit for defective connections**
- 63 Repair defective connections**
- 64 Interpret wiring diagram**
- 65 Clean drain line**
- 66 Check all electrical components for voltage and current**
- 67 Check and/or change compressor oil**
- 68 Clean condenser coil surface (air cooled/water cooled)**
- 69 Perform all aspects of preventive maintenance**

Connections

- Secretary's Commission on Achieving Necessary Skills (SCANS)**
- National Center for Construction Education Research (NCCER)**
- 21st Century Skills**
- Common Core State Standards ELA and Math**
- Interdisciplinary Course**

	Commercial Refrigeration 470211	
Course Description		
Develops techniques for servicing and troubleshooting mechanical and electromechanical refrigeration components. Electrical and refrigeration safety are emphasized. Proper tool use and environmentally sound refrigerant handling are taught.		
Content/Process		
1	Practice/observe safety practices/procedures	
2	Define types of metering devices: capillary tubes, TXV, AEV, low side float, high side float, hand expansion valve, restrictor orifices	
3	Evaluate system performance when using different types of flow control devices	
4	Adjust and size devices when and where appropriate	
5	Identify types of compressors: hermetic, open type, and semi-hermetic	
6	Identify methods of compression: centrifugal, rotary, screw, scroll, and reciprocating	
7	Select the compressor based on cooling load	
8	Explain the methods of compression	
9	Determine the system balance based on the selected components	
10	Explain methods of unloading cylinders (capacity control)	
11	Properly identify the location of all accessories in a refrigeration system	
12	Determine appropriate accessories for systems application	
13	Explain the operation of the accessories in a refrigeration system	
14	Calculate pressure drop in liquid line risers	
15	Size double risers	
16	Size hot gas line	
17	Size liquid line from condenser to receiver	
18	Explain the multiplex system	
19	Explain the cascade system	
20	Explain how to set superheat on a multiplex system	
21	Explain the heat reclaim cycle (three way valve)	
22	Explain the head pressure control system (flooded condenser)	

23	Adjust EPR valve	
24	Check control circuits according to manufacturer's specifications	
25	Check the CPR valve	
26	Check system for full refrigerant charge	
27	Explain the difference between medium temperature, low temperature, and ultra low temperature storage systems	
28	Explain the operation of: air screen freezer, glass door freezer, and coffin cases	
29	Explain the different methods of defrost: electric resistance, hot gas, and cool gas	
30	Replace anti-sweat heaters	
31	Replace fan motors and fans	
32	Check and/or replace fan relay	
33	Verify air flow	
34	Demonstrate good customer relations	
35	Read electrical wiring diagrams and demonstrate understanding of wiring diagrams	
36	Develop a systematic way to diagnose system problems and demonstrate in class	
37	Determine cause of failure in system components	
38	Identify and describe possible causes of failure and how to eliminate causes	
39	Demonstrate use of tools and test equipment while following safety practices	
40	Verify system operation	
41	Write service report	
42	Determine capacities of refrigerant lines	
43	Determine equivalent lengths of fittings	
44	Calculate total effective length of pipe runs	
45	Calculate amount of refrigerant in lines	
46	Describe use of traps in suction risers	
47	Explain the effects of pressure drop in the refrigeration system	

	<p style="text-align: center;">Connections</p> <ul style="list-style-type: none">• Secretary's Commission on Achieving Necessary Skills (SCANS)• National Center for Construction Education Research (NCCER)• 21st Century Skills• Common Core State Standards ELA and Math• Interdisciplinary Course	
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	Industrial Safety	
	460301	
Course Description		
<p>This course provides practical training in industrial safety. The students are taught to observe general safety rules and regulations, to apply work site and shop safety rules, and to apply OSHA regulations. Students are expected to obtain certification in first aid and cardiopulmonary resuscitation.</p>		
Content/Process		
1	Apply work site and lab safety procedures	
2	Apply personal safety rules and procedures	
3	Apply fire prevention rules and procedures	
4	Obtain first aid certification	
5	Obtain CPR certification	
6	Demonstrate hazardous communications procedures	
7	Describe and demonstrate universal precautions procedures	

Connections

- **Secretary's Commission on Achieving Necessary Skills (SCANS)**
- **National Center for Construction Education Research (NCCER)**
- **21st Century Skills**
- **Common Core State Standards ELA and Math**

	<div>Heat Pump Application</div> <div>460801</div>	
Course Description		
Explains reverse cycle heating systems, defrost cycles, reversing valves, and auxiliary heating. This course will also concentrate on the line and control voltage circuitry pertaining to these units. ARI Controls: Subtopic E; Heat Pump Systems: Subtopics A and B; System Installation and Start-Up: Subtopic C; System Servicing and Troubleshooting: Subtopic E		
Content/Process		
1	Practice/observe safety procedures/techniques	
2	Explain the operation and function of a reversing valve	
3	Identify the main types of defrost controls	
4	Explain the operation of each type of defrost control	
5	Describe the purpose and function of outdoor thermostats	
6	Describe the sequence and purpose of emergency heat controls	
7	Describe the purpose and function of flow control valves	
8	Install or replace a heat-sequencing relay	
9	Explain the basic theory of heat pump operation	
10	Identify and explain the operation and function of the electrical and mechanical components of the heat pump	
11	Compare heat pump systems based on performance rating information: COP, SEER, balance points, economics	
12	Analyze and explain the refrigerant cycle in both heating and cooling modes	
13	Identify and describe different types of heat pump systems: air to air, water to air, water to water, air to water, air to ground, open loop, and closed loop	
14	Analyze and compare the operation and performance of the different types of heat pump systems	
15	Demonstrate good customer relations	
16	Explain the importance of manufacturers' installation and operation requirements	
17	Determine equipment electrical requirements	

18	Verify equipment air flow and distribution	
19	Check operation of all electrical components including control components	
20	Check system operation in the heating and cooling modes while following safety procedures	
21	Follow local codes and ordinances during installation and repair	
22	Read and demonstrate an understanding of electrical wiring diagrams	
23	Develop systematic way to diagnose system problems and demonstrate method in class	
24	Determine the cause of failure in a system	
25	Identify and describe all possible causes of failure and how to eliminate causes	
26	Use appropriate tools and test equipment while following safety practices	
27	Explain the operation of the refrigeration cycle in heating and cooling modes	
28	Test operation and control of supplementary and emergency heat	
29	Verify system operation	
30	Write a service report	

Connections

- Secretary's Commission on Achieving Necessary Skills (SCANS)
- National Center for Construction Education Research (NCCER)
- 21st Century Skills
- Common Core State Standards ELA and Math
- Interdisciplinary Course

	<div>Electrical Components</div> <div>470216</div>	
Course Description		
This course defines the electrical components of an air conditioning system. Different types of line voltages, wiring diagrams, and solid-state devices are included. Safety is emphasized.		
TASK LIST		
1	Practice/observe safety procedures/techniques	
2	Measure voltage with digital and analog voltmeters	
3	Measure AC current with a clamp-on ammeter	
4	Measure resistance with an ohmmeter	
5	Check winding insulation with a megohmmeter	
6	Check voltage with a voltage tester	
7	Use a continuity tester to determine whether an open circuit exists	
8	Use a capacitance meter to measure capacitance of both run and start capacitors	
9	Define watts, ohms, volts, amps	
10	Define and compare single and multi-phase voltage and current	
11	Demonstrate proper use of ohmmeter, ammeter, voltmeter	
12	Calculate electrical circuit loads	
13	Use appropriate meters to check fuses and breakers	
14	Use appropriate meter to determine wattage, resistance, voltage, and amperage	
15	Interpret tables and charts from National Electrical Code (NEC)	
16	Figure wire sizes and voltage drop	
17	Draw and identify power transformer types	
18	Use electrical meters appropriately to test and identify voltages and phase	
19	Size and test fuses and breakers and safely replace them	
20	Use NEC tables to size EMT	
21	Define relays, sequencers, contactors, capacitors, defrost timers, crankcase heaters, water valves, damper actuators, thermostats,	

	controllers, rheostats, zone valves, solenoids	
22	Explain the operation and application of: split phase motors, three phase motors, variable speed motors, shaded pole motors, and permanent split capacitor motors	
23	Demonstrate proper use of testing equipment for motors	
24	Interpret detailed instructions for wiring circuits	
25	Draw electrical circuits in accordance with standard wiring procedures	
26	Wire actual electrical circuits from wiring diagrams	
27	Demonstrate the use and understanding of basic electrical meters by wiring and testing actual circuits	
28	Explain the use of various electrical components in HVACR	
29	Interpret schematic wiring diagrams into a sequence of operation for HVACR equipment	
30	Analyze the electrical performance of each component and control	
31	Rewire a HVACR unit using a schematic diagram	
32	Develop an approved routine for electrical troubleshooting	
33	Use electrical test instruments appropriately to test and correct the performance of electrical systems	

Connections:

- *Common Core State Standards
- *KOSSA
- *Common Core Technical Standards
- *New Generation Science Standards
- CTSO's – Skills

INTERNSHIP EDUCATION

460883

Course Description:

Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation.

Content/Process

The Student Will:

- 1. Gain career awareness and the opportunity to test career choice/s.**
- 2. Receive work experience related to career interests prior to graduation.**
- 3. Integrate classroom studies with work experience.**
- 4. Receive exposure to facilities and equipment unavailable in a classroom setting.**
- 5. Increase employability after graduation.**

Connections

- Kentucky Occupational Skills Standards Assessment**
- National Center for Construction Education research.**
- Common Core Standards.**
- 21st Century Skills**

**SHEET METAL FABRICATION
460847**

Course Description

The student will learn to make patterns and lay out and construct common sheet metal duct fittings.

Content/Process

1	Lay out and construct common sheet metal duct fittings	
2	Construct duct connectors of all shapes and sizes.	
3	Construct duct couplings of all shapes and sizes.	
4	Construct three-way and four-way duct fittings of various sizes.	
5	Lay out a duct system for a residence or commercial building.	
6	Install duct system in a residence or commercial building.	

Connections:

- *Common Core State Standards
- *KOSSA
- *Common Core Technical Standards
- *New Generation Science Standards
- *Post-Secondary: KCTCS ACR112
- CTSO's – Skills USA

ICE MACHINES

460845

Course Description		
Introduces the operation, checking, adjusting, and troubleshooting of commercial ice makers. The student will learn to adjust, check, clean, and troubleshoot commercial ice machines.		
<i>Prerequisites: ACR 100 and ACR 102</i>		
Content/Process		
1	Practice/observe safety procedures/techniques	
2	Explain the operation of ice making	
3	Follow manufacturers' instructions for cleaning the evaporator	
4	Clean the condenser	
5	Check the harvest cycle	
6	Adjust cube size	
7	Check for and repair leaks	
8	Inspect the electrical circuit	
9	Adjust the metering device for proper operation	
10	Measure grid heater current when applicable	
11	Clean ice storage bin	
12	Inspect and clean drains as necessary	
13	Replace bearings in flake-type machine	
14	Check and adjust the water level	
15	Check and adjust water pressure	
16	Level machine	
17	Check water pump	
18	Explain water spray system for ice making	
19	Treat water properly	

Connections

- Secretary's Commission on Achieving Necessary Skills (SCANS)
- National Center for Construction Education Research (NCCER)
- 21st Century Skills
- Common Core State Standards ELA and Math
- Interdisciplinary Course

HEAT LOAD DUCT DESIGN

480812

Course Description:

Introduces the fundamentals needed to calculate heat gain and heat loss, thereby determining air conditioner/furnace size. This information will be used to calculate the correct duct size. Procedures to lay out a duct system as outlined in ACCA MANUAL D are presented.

Content/Process

Students will:

- 1 Define "U" value
- 2 Define "K" value
- 3 Define "C" value
- 4 Define "R" value
- 5 Interpret heat transfer tables ("U", "K", "C", "R")
- 6 Calculate total heat transfer value of any surface (R) - (U)
- 7 Explain the heat load sources: conduction, infiltration, product, miscellaneous loads (people, motors, equipment)
- 8 Explain the purpose of vapor barriers
- 9 Interpret tables of specific heat values, latent heat, and heat of respiration
- 10 Identify various points on a psychrometric chart
- 11 Calculate: refrigeration-sensible heat ratio, contact factor, latent heat, sensible heat, total heat, water removal, mixed air condition
- 12 Explain: specific humidity, apparatus dew point, contact factor, relative humidity, dry-bulb, wet-bulb, dew point, and enthalpy
- 13 Plot and chart psychrometric terms
- 14 Determine total resistance to heat flow ("R"), ("U")
- 15 Interpret structure design data
- 16 Interpret building prints - size of rooms, etc.
- 17 Calculate conduction loss for: walls, roof, floors, windows, basement (walls, floor), unconditioned space
- 18 Calculate infiltration: doors, windows

- 19 Calculate ventilation load
- 20 Calculate duct loss
- 21 Calculate "U" values for building materials
- 22 Calculate CLTD (Cooling Load Temperature Difference)
- 23 Make corrections for CLTD
- 24 Calculate conduction loads for: walls, roofs, windows, doors, non-conditioned space, floors
- 25 Calculate lighting load
- 26 Determine size of equipment needed
- 27 Calculate infiltration and ventilation
- 28 Calculate duct gain
- 29 Calculate refrigeration-sensible heat ratio
- 30 Practice/observe safety procedures/techniques
- 31 Draw layout of return and supply runs
- 32 Calculate equivalent length of trunk and branch ducts
- 33 Calculate total effective length of duct runs
- 34 Calculate total available static pressure
- 35 Size trunk and branch ducts by equal friction method
- 36 Use duct calculator to find duct size, velocity, CFM, and friction loss
- 37 Calculate air flow factors for heating and cooling
- 38 Size registers, grills, and diffusers
- 39 Identify types of mechanical filters: disposable, permanent foam, mesh, fiber, and high efficiency
- 40 Describe operation of electronic air cleaners
- 41 Install air cleaner system into existing ductwork
- 42 Identify different types of fans: centrifugal, axial, etc.
- 43 Determine the direction of rotation
- 44 Check for proper rotation
- 45 Explain the difference between tube-axial and vane-axial
- 46 Interpret the fan curve
- 47 Select the fan via the curve
- 48 Check fan performance via curves
- 49 Identify the types of centrifugal fans: forward curved, backward curved, air foil, and

radial tip

- 50 Determine air velocity within a duct via: Pilot tube and inclined manometer**
- 51 Determine air velocity at grills and diffusers via: deflecting vane anemometer, voltmeter, hot wire anemometer, pilot tube, and rotating vane anemometer**

Connections

- **Secretary's Commission on Achieving Necessary Skills (SCANS)**
- **National Center for Construction Education Research (NCCER)**
- **21st Century Skills**
- **Common Core State Standards ELA and Math**
- **Interdisciplinary Course**

COOPERATIVE EDUCATION

460880

Course Description	
Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.	
<i>Prerequisites: Consent of Instructor</i>	
Content/Process	
1	Gain career awareness and the opportunity to test career choice(s)
2	Receive work experience related to career interests prior to graduation
3	Integrate classroom studies with work experience
4	Receive exposure to facilities and equipment unavailable in a classroom setting
5	Increase employability potential after graduation
6	Earn funds to help finance educational expenses
	Connections <ul style="list-style-type: none">• Secretary's Commission on Achieving Necessary Skills (SCANS)• National Center for Construction Education Research (NCCER)• 21st Century Skills• Common Core State Standards ELA and Math• Interdisciplinary Course

Journeyman Preparation

4460846

Course Description

A series of lectures, discussions, and presentations pertaining to the proper application of HVAC codes. The class will help prepare the student to pass the Kentucky Journeyman HVAC licensing exam.

Content/Process

1	Explain the importance of local licensing codes
2	Explain how the codes affect the installation and operation of HVAC equipment
3	Explain the relationship between manufacturers' suggested installation procedures and codes
4	Explain the importance of codes as they pertain to safety
5	Compare commercial codes and codes that pertain to residential applications
6	Demonstrate knowledge of codes that relate to the installation of HVAC equipment
7	Review major components of HVAC

Connections:

- ***Common Core State Standards**
- ***KOSSA**
- ***Common Core Technical Standards**
- ***New Generation Science Standards**
- ***Post-Secondary: KCTCS ACR 290**
- **CTSO's – Skills USA**

HVAC ELECTRICITY

460817

Course Description:

This course introduces students to the basic physics of electricity. Students apply Ohm's law; measure resistance, voltage, ohms, watts and amps; construct various types of electrical circuits; select wire and fuse sizes; and learn to troubleshoot an electric motor and motor controls.

Content/Process

Students will:

- 1 Practice electrical safety**
- 2 Measure ohms with an ohmmeter**
- 3 Measure voltage with a voltmeter**
- 4 Measure amps with an ammeter**
- 5 Measure watts with a wattmeter**
- 6 Solve electrical circuit problems using Ohm's Law**
- 7 Draw and interpret electrical symbols**
- 8 Construct series circuits**
- 9 Construct parallel circuits**
- 10 Construct series-parallel circuits**
- 11 Connect, operate, and identify the types of single-phase motors**
- 12 Measure the resistance of windings in a split-phase motor and identify the start/run windings**
- 13 Test capacitors**
- 14 Select wire and fuse sizes**
- 15 Test transformers**
- 16 Locate faults in electrical circuits**
- 17 Identify types of 3-phase power supplies**
- 18 Troubleshoot magnetic motor starters and coils**

Connections

Secretary's Commission on Achieving Necessary Skills (SCANS)

National Center for Construction Education Research (NCCER)

21st Century Skills

Common Core State Standards ELA and Math

Interdisciplinary Course

GREEN AWARENESS/ENERGY MANAGEMENT

460806

Course Description		
This course will instruct students in the areas of energy management and analysis, green heating, ventilation, air conditioning and refrigeration. It will also cover electrical generation and consumption as well as green plumbing.		
Content/Process		
1	Review safety rules and student responsibilities	
2	Discuss core renewable energy and sustainable energy	
3	Discuss commercial building energy consumption surveys	
4	Explain different energy conservation measures	
5	Discuss the importance of energy audits	
6	Explain energy consumption and demand analysis	
7	Introduce heat load calculations	
8	Explain life equipment life cycle and cost analysis	
9	Cover HVAC energy efficiency Ratio	
10	Discuss HVAC seasonal energy efficiency ratio SEER	
11	Discuss HVAC heating season performance factors	
12	Explain HVAC coefficient of performance	
13	Discuss and test HVAC ventilation and indoor air quality	
14	Review mechanical HVAC equipment	
15	Discuss evaporative cooling and passive cooling systems	
16	Explain solar cooling and thermal storage systems	
17	Introduce commercial refrigeration and U.S EPA Green Chill Advanced Refrigeration Partnership	
18	Discuss refrigeration replacement equipment	
19	Review heating combustion analysis	
20	Review forced air heating systems	

21	Review condensing furnaces and modulating furnaces	
22	Explain condensing boilers and instantaneous boilers	
23	Explain solar hot water and comfort heating systems	
24	Discuss waste water heat recovery	
25	Discuss radiant panel systems and thermal mass	
26	Explain optimized steam systems and steam traps	
27	Review geothermal systems and air to air heat pumps	
28	Review package terminal air conditioning	
29	Review mini-split AC systems	
30	Define and discuss electrical power and nuclear power	
31	Explain fuel cells	
32	Introduce photovoltaic and wind turbines as power sources	
33	Discuss lighting florescence versus LED	
34	Explain tidal and ocean energy applications	
35	Explain ghost loads	
36	Review and discuss residential appliance energy usage	
37	Introduce potable water conservation flow restriction faucets, showerheads, pre-rinse waterless urinals	
38	Discuss high efficiency plumbing appliances: clothes washers, dishwashers, ice machines, garbage disposals	
39	Introduce hot water distribution systems	
40	Introduce hot water circulating systems	
41	Explain different types of water heating systems storage tank, tankless, heat pump water heaters, indirect, and solar	
42	Explain first hour rating system	
43	Explain rain water harvesting	
44	Explain drain water heat recovery systems	
45	Explain industrial fire protection systems and residential fire protection systems	
46	Explain Green plumbing systems relevance to LEED	
47	All students will take the Green Mechanical Certification Exam	

Connections:

- | |
|--|
| <ul style="list-style-type: none">• *Common Core State Standards• *KOSSA• *Common Core Technical Standards• *New Generation Science Standards• *Post-Secondary: KCTCS ACR280• CTSO's – Skills USA |
|--|

COOLING & DEHUMIDIFICATION

470213

	Course Description: Explains the working characteristics of air conditioning units with air and water cooled condensers. Line, low voltage and pneumatic controls will also be covered. ARI - Air Conditioning Systems: Subtopics A-E; System Installation and Start-Up: Subtopic D; System Servicing and Troubleshooting: Subtopic D; Controls: Subtopic
	Content/Process
1	Practice/observe safety procedures/techniques
2	Describe "air conditioning"
3	List the benefits of "conditioned" air
4	Describe some of today's current issues regarding air conditioning - industry concerns and future ramifications
5	Describe the difference between "split systems" and "package systems"
6	Describe the sequence of the basic refrigeration cycle and operation of the air conditioning system
7	Use and read various tools and instrumentation needed for checking, testing, and operating air conditioning systems
8	Define the types of condensers: air cooled, water cooled, evaporative
9	Adjust the air flow for proper temperature difference
10	Describe maintenance of a condenser and a cooling tower
11	Analyze air conditioning systems and appropriately diagnose the electrical and/or mechanical problems
12	Demonstrate good customer relations in a classroom simulation
13	Explain the importance of manufacturers' installation and operation requirements
14	Determine equipment electrical requirements
15	Verify equipment air flow and distribution requirements
16	Check operation of all electrical components including control components
17	Demonstrate the use of tools and test equipment
18	Check system operation while following all safety procedures

19	Follow local codes and ordinances during installation and repair
20	Read and demonstrate understanding of electrical wiring diagrams
21	Develop a systematic way to diagnose system problems and demonstrate in class
22	Determine the cause of failure in a system
23	Identify and describe possible causes of failure and how to eliminate them
24	Demonstrate the use of tools and test equipment while following safety practices
25	Verify system operation
26	Write a service report
27	Identify types of control systems: electromechanical, pneumatic, electronic, and programmable
28	Identify control system components
29	Describe the sequences of operation in all types of control systems
30	Construct a schematic diagram using all components necessary to safely operate an air conditioner
31	Program a programmable thermostat for heating, cooling, and heat pump operation including set up and set back
32	Plot and chart psychrometric terms.
	Connections:
	<ul style="list-style-type: none"> • *Common Core State Standards • *KOSSA • *Common Core Technical Standards • *New Generation Science Standards • *Post-Secondary: KCTCS ACR280 • CTSO's – Skills USA

	<div>Residential Energy Auditor Prep</div> <div>460804</div>	
Course Description		
This course will provide step by step instruction and best practices involved in performing a residential energy audit. Ethics and customer relations, energy consumption and quality control inspecting. Building shell diagnosing, shell leakage, evaluating heating systems. Evaluation base load measures, windows, doors, and exterior insulation evaluations. Mobile homes and health and safety issues are also covered.		
Permission of the Instructor		
Content/Process		
1	Students will receive safety training applied to energy auditing	
2	Discuss the purpose of an energy audit	
3	Explore the energy auditing process, visual inspection/ diagnostics testing/ numerical analysis	
4	Students will be instructed on understanding energy usage/ base load usage/seasonal usage/ energy index/electrical peak load/carbon foot print	
5	Examine differences of work inspections/ in progress inspections/ final inspections/quality assurance/energy auditing gas and ethics	
6	Students will practice customer relations/ communication skill/customer interview/ best sales practices	
7	Students will practice customer education/ reducing heating consumption/ hot water and laundry/ cooling consumption	
8	Students will receive instruction on using Infrared and thermal scanning	
9	Students will practice evaluating attic and roof insulation/ story and a half homes and closed roof cavities	
10	Students will practice evaluating walk-up stair ways and doors/ retractable attic stairways	
11	Students will perform evaluation of wall insulation	
12	Student will identify thermal bounding decisions/ determining floor and foundation insulation	
13	Students will observe and learn about air leakage problems and solutions	
14	Discuss safety considerations for air leakage	
15	Discuss goals of air leak testing/ use of blower door	

16	Discuss and practice air sealing approaches	
17	Evaluate heating system replacement	
18	Perform inspection of gas and oil furnaces	
19	Discuss wood stoves safety and venting	
20	Test draft and venting of combustion air	
21	Discuss combustion safety	
22	Practice leak testing gas piping	
23	Perform co carbon monoxide testing pap	
24	Discuss ways of improving inadequate draft	
25	Evaluate chimneys and liners and safety	
26	Evaluate duct air distribution	
27	Practice evaluating duct leakage	
28	Discuss duct insulation and type	
29	Discuss instructions and installation of programmable thermostats	
30	Perform electric heating inspections	
31	Perform heat pump inspections	
32	Practice evaluating central air conditioning system	
33	Practice air conditioning equipment sizing	
34	Check duct leakage and air flow	
35	Practice ac unit charge check	
36	Complete water heater inspection gas/ electric/ tankless/solar	
37	Evaluate water heater energy savings	
38	Take refrigerator evaluation and watt metering readings	
39	Discuss lighting improvements	
40	Explore different window shading/ treatments interior and exterior	
41	Observe and discuss landscaping for shade	
42	Discuss exterior storm windows	
43	Evaluate window replacement and weather striping	
44	Determine R value of exterior insulation and siding	
45	Discuss and evaluate health and safety issues pollutant sources and Co	

46	Evaluate moisture problems and mold	
47	Discuss crawl space moisture control	
48	Inform students about lead - safe weatherization	
49	Practice electrical safety	
50	Review ASHRAE 6.2.2-2007 ventilation standards	
51	Evaluate whole house ventilation systems	
52	Explore mobile home general auditing task	
53	Practice evaluating mobile home insulation	
54	Practice evaluating belly and side wall insulation	
55	Perform evaluation of shell leakage	
56	Discuss evaluation of windows and doors/replacement	

Connections:

***Common Core State Standards**

***KOSSA**

***Common Core Technical Standards**

***New Generation Science Standards**

***Post-Secondary: KCTCS ACR280**

CTSO's – Skills USA

	DIGITAL LITERACY 480101	
Course Description		
The impact of computers on society, and ethical issues are presented. Students use a microcomputer and application software, including word processing, database, spreadsheets, presentation software, and the Internet, to prepare elementary documents, reports, and electronic presentations.		
Content/Process		
1	Use a word processing program to create, save, print, modify, spell-check, and grammar-check a simple document	
2	Use a word processing program to enhance the appearance of a simple document by using centered, right-justified, boldfaced, underlined, and italicized text	
3	Use a word processing program to change the default margins and line spacing	
4	Use a word processing program to create a document with headers, footers, and footnotes	
5	Use an electronic spreadsheet to create, save, print, modify, and obtain graphs from a simple spreadsheet.	
6	Use an electronic spreadsheet to perform basic mathematical operations including, but not limited to addition, subtraction, multiplication, and division	
7	Use an electronic spreadsheet to calculate averages and percent's	
8	Use an electronic spreadsheet program to enhance the appearance of a spreadsheet by changing fonts, foreground and background colors; and centering text across columns	
9	Use a database management program to create, maintain, and print reports from a simple relational database	
10	Use a database management program to customize the user interface by creating and maintaining forms and reports	
11	Use a database management program to query tables using basic query operations such as "and", "or", "not", etc.	
12	Print in landscape and portrait orientations	
13	Use the component of the operating system that helps the user manipulate files and folders to copy, move, rename, and delete files; and to create,	

	copy, move, rename, and delete folders	
14	Use a World Wide Web browser to navigate hypertext documents and to download files	
15	Use Internet search engines and understand their advantages and disadvantages	
16	Use an electronic mail program to send and receive electronic mail	
17	Discriminate between ethical and unethical uses of computers and information including e-mail and internet etiquette	
18	Demonstrate a basic understanding of issues regarding software copyright, software licensing, and software copying	
19	Demonstrate an awareness of computer viruses and a basic understanding of ways to protect a computer from viruses	
20	Demonstrate a basic understanding of the impact of computers on society	
21	Use and understand basic computer terminology	
22	Identify types of computers, how they process information and how individual computers interact with other computing systems and devices	
23	Identify the function of computer hardware components	
24	Identify the factors that go into an individual or organizational decision on how to purchase computer equipment	
25	Identify how to maintain computer equipment and solve common problems relating to computer hardware	
26	Identify how software and hardware work together to perform computing tasks and how software is developed and upgraded	
27	Identify different types of software, general concepts relating to software categories, and the tasks to which each type of software is most suited or not suited	
28	Identify what an operating system is and how it works, and solve common problems related to operating systems	
29	Manipulate and control the Windows desktop, files, and disks	
30	Identify how to change system settings, install and remove software	
31	Be able to start and exit a Windows application and utilize sources of online help	
32	Identify common on-screen elements of Windows applications, change application settings and manage files within an application	
33	Describe and implement the protocol of utilizing presentation software.	

34	Use a presentation program to create, save, modify, spell check, and grammar-check a simple presentation.	
35	Deleted Task	
36	Use a presentation program to enhance the appearance of the slide designs, background colors, and layout.	
37	Utilize the print features in a presentation to include handouts, speaker's notes, and black and white.	

Connections:

***Common Core State Standards**

***KOSSA**

***Common Core Technical Standards**

***New Generation Science Standards**

***Post-Secondary: KCTCS DLC 100**

CTSO's – Skills USA

Heating and Humidification

460820

Course Description

Explains heating systems from simple fossil fuel furnaces through more complex systems. This course will also concentrate on the line and control voltage circuitry pertaining to these systems. ARI Controls: Subtopics A-C; Heating Systems: Subtopics A-C; System Installation and Start-Up: Subtopics A and B; System Servicing and Troubleshooting: Subtopic C; Tools and Equipment: Subtopic D

Content/Process

1	Practice/observe safety procedures/techniques	
2	Adjust valves	
3	Check coil resistance of a valve coil	
4	Test gas valve operation	
5	Check the voltage at gas valve operator	
6	Check pressure at inlet vs. outlet of gas valve	
7	Perform a regular conversion on a gas valve from natural gas to LP or reverse: low, line voltage, redundant, two-stage, and modulating	
8	Explain the operation of a solenoid valve	
9	Explain direct vs. servo regulation	
10	Identify limited, non-adjustable and adjustable regulators	
11	Determine application of gas valves	
12	Differentiate between pilot proving devices	
13	Explain the operation of flame rod, mercury flame switch, bimetal, and millivolt flame sensors	
14	Test and change a thermocouple flame sensor	
15	Test spark ignition modules	
16	Perform safety lockout procedures for burners	
17	Measure resistance of a cad cell during operation	
18	Explain the operation of an oil delay valve	
19	Identify and install residential heating and cooling thermostats	
20	Test a fan/limit control to identify a set point of control	

21	Wire a complete heating system - line and low voltage	
22	Identify controls for heating and cooling	
23	Wire a humidistat into electrical circuit	
24	Wire control circuit for electronic air cleaner	
25	Test and adjust the fuel system of furnace	
26	Check the ignition system	
27	De-rate or change over a gas burner	
28	Adjust burner system to recommended efficiency	
29	Check for proper temperature rise across the furnace	
30	Test all safety controls	
31	Set proper air distribution in house	
32	Remove, install, and adjust blower motor and/or belt	
33	Clean the pilot assembly	
34	Adjust the regulator	
35	Observe proper draft conditions	
36	Oil motor(s) and bearings	
37	Check and adjust the heat anticipator	
38	Check circulator for alignment and lubrication	
39	Set aquastat	
40	Check water-regulating valve operator	
41	Inspect/change zone valve operator	
42	Remove air from water system	
43	Wire a multizone/multipump hydronic system	
44	Identify types of hydronic piping systems	
45	Test boiler efficiency and clean if necessary	
46	Oil motor(s)	
47	Check and adjust the heat anticipator	
48	Perform pressure checks on the fuel system	
49	Perform pressure checks on the venting system	
50	Measure temperature difference across heating and cooling	

	equipment	
51	Adjust individual register outlets to properly balance system	
52	Describe the reasons for codes	
53	Discuss three model codes: Boca, standard, uniform	
54	Identify the codes and standards for the applicable area, locality, or state	
55	Discuss the relationship between codes and manufacturers' installation instructions	
56	Identify standards not covered by codes: ARI, ASHRAE, SMACNA	
57	Demonstrate good customer relations in a classroom simulation	
58	Explain the importance of manufacturers' installation and operation requirements	
59	Determine equipment electrical requirements	
60	Verify equipment air flow and distribution requirements	
61	Check operation of all electrical control components	
62	Check operation of gas train components and measurements	
63	Demonstrate use of tools and instruments	
64	Check oil burner components and measurements	
65	Check ignition systems while following all safety principles	
66	Evaluate fuel supply systems	
67	Test for proper combustion	
68	Check electrical components for operation and wiring connections	
69	Check for correct heating input and adjust to manufacturers' specifications	
70	Read electrical wiring diagrams and demonstrate an understanding of wiring diagrams	
71	Use tools and test equipment appropriately while following safety practices	
72	Demonstrate an understanding of combustion theory	
73	Determine air requirements	
74	Develop a systematic way to diagnose system problems and demonstrate in class	
75	Determine cause of failure in a heating system	

76	Identify and describe all possible causes of failure and how to eliminate causes	
77	Verify system operation	
78	Write a service report	
79	Measure chimney draft with a draft gauge	
80	Perform an efficiency test on an oil-gas burner: smoke test, CO2 test, and O2 test	
81	Determine the efficiency of an oil pump using a vacuum gauge and a pressure gauge	
82	Determine the relative humidity using a sling psychrometer	
83	Measure gas pressure with a U-tube manometer	

Connections:

*Common Core State Standards

*KOSSA

*Common Core Technical Standards

*New Generation Science Standards

*Post-Secondary: KCTCS CAR 240

CTSO's – Skills USA

FUNDAMENTALS OF MATHEMATICS

470818

Course Description		
This course concentrates on basic math and is designed to assist the student in mastering and applying math skills in the areas of whole numbers, fractions, decimals, percentages, basic measurements, simple equations, ratio and proportions, computed measurements, tables and graphs, and use of the hand-held calculator.		
Prerequisites: None		
Content/Process		
1	Without the use of a calculator, perform the fundamental arithmetic operations on whole numbers with accuracy and speed	
2	Without the use of a calculator, perform the fundamental arithmetic operations on fractions with accuracy and speed	
3	Without the use of a calculator, perform the fundamental arithmetic operations on decimals with accuracy and speed	
4	Without the use of a calculator, perform the fundamental arithmetic operations on percentages with accuracy and speed	
5	Perform basic processes in problems dealing with English and metric units of measure	
6	Perform conversions interchanging the English and metric systems of measure with accuracy	
7	Utilize ratio/proportions	
8	Apply basic formulas	
9	Calculate area, volume, and perimeter of basic shapes to include squares, rectangles, and circles	
10	Read and interpret tables and graphs	
11	Use scientific calculators	

Connections:

*Common Core State Standards

*KOSSA

*NCCER

*Common Core Technical Standards

*Post-Secondary: KCTCS MTH 100

CTSO's – Skills USA